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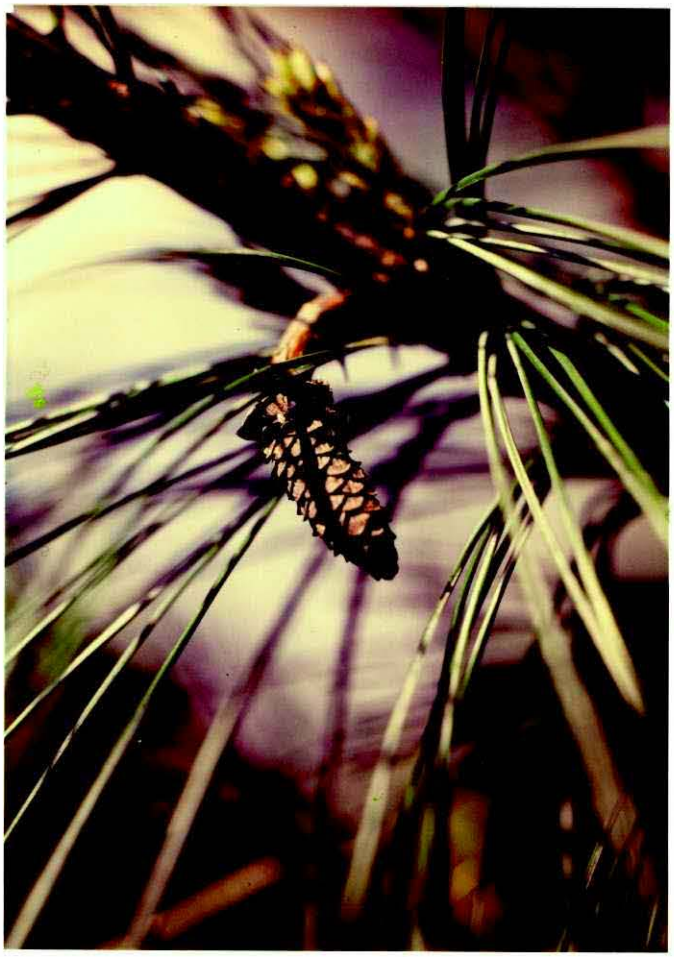
ON THE EDWARDS SEED ORCHARD, MORGANTON, NC 1979



SOUTHEASTERN AREA, STATE & PRIVATE FORESTRY
USDA FOREST SERVICE, ATLANTA, GA 30309

AN EVALUATION OF WHITE PINE CONE BEETLE CONE LOSSES ON THE EDWARDS SEED ORCHARD, MORGANTON, NC 1979

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INTRODUCTION

Southern seed orchard entomologists have documented that seed and cone insects are, at times, the limiting factor to increased seed production in southern seed orchards. White pine seed orchards often experience a complete loss of their cone crops following attacks of the white pine cone beetle. DeBarr et al. (unpublished) documented a 96 percent cone loss in 1975, on the North Carolina Division of Forestry's Edwards Seed Orchard on untreated trees. While this is an extremely high loss, it is not unprecedented. Others have reported nearly complete cone crop failures attributable to the white pine cone beetle.

INSECT PEST

The white pine cone beetle, Conophthorus coniperda (Schwarz), adults emerge in April and fly to the tree crowns to attack the cone crop. The adult beetle chews into the cone at the base of the petiole. At the point of attack, a typical pitch tube is produced (figure 1). The female beetle mates and continues her gallery along the cone axis in which she often lays eggs. She then leaves the cone and initiates an attack on two or three additional cones. After only 1 or 2 weeks, the attacked cones wither and fall from the tree--there the larvae mature and remain until the following spring.

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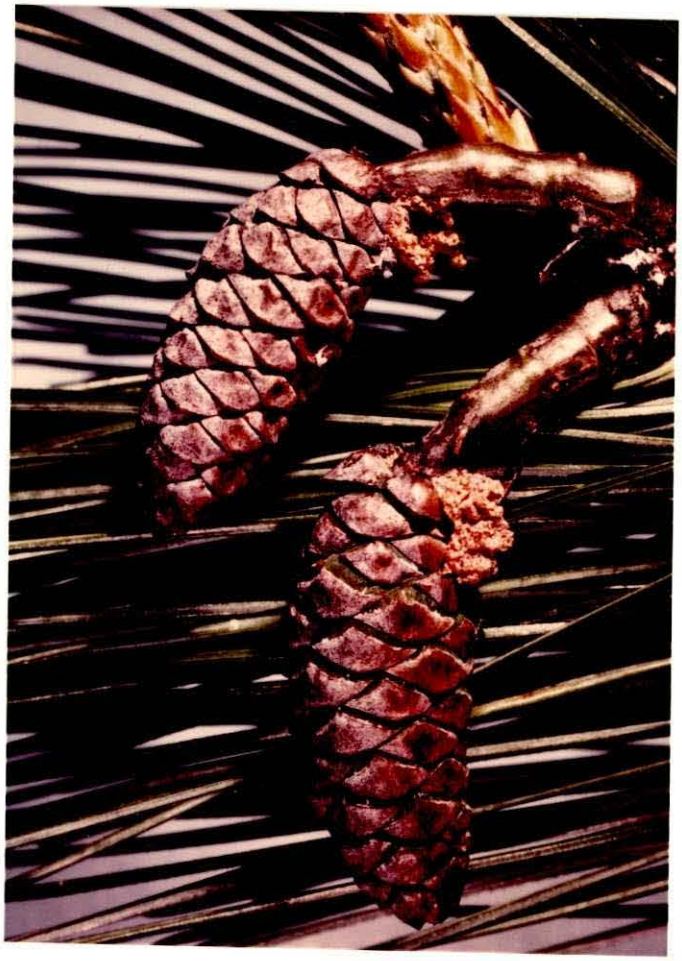
Figure 1. Typical pitch tube produced by the white pine cone beetle



OBJECTIVE

The objective of this evaluation was to determine the white pine cone beetle induced losses to the white pine cone crop following carbofuran[5/] 10 G applications of 4, 6 and 8 ounces per inch d.b.h.

[5/] Furadan® is the trade name for carbofuran.

MATERIALS AND METHODS

Carbofuran was applied to three blocks of grafted white pine trees, i.e. 4, 6 and 8 ounces per inch d.b.h. The 4 and 6 ounce rates were applied the last week of February 1979, while the 8 ounce rate was applied the first week of December 1978. In 1978, during February, all three areas were treated with carbofuran at the 8 ounce rate. There was an additional fourth block consisting of two rows of trees which received no chemical treatment in either 1978 or 1979.

The 10 percent granular carbofuran was applied both years with a Turner applicator, a "homemade" device which is basically a modified corn planter. The granules were dispensed into two trenches about 3 inches under the soil surface. There were two application trenches on each side of each tree.

Six clones (two ramets of each) were selected as sample trees for this evaluation in each treatment block. The same six clones were used throughout the evaluation.

On May 15, 1979, four sample branches containing cones were selected on each tree. An aluminum tag was secured to each branch and given a reference number. Each cone was checked to determine whether or not it had been attacked by the cone beetle (presence of pitch tube). The cones were re-examined on May 29, 1979. Cones that had been under attack 2 weeks before, but were still alive (determine by increase in cone length) and showing no fresh pitch or frass were considered healthy. Other cones remaining on the tree were categorized as either healthy or dead. Cones that were missing from the previous observation were considered to have been killed by the beetle.

RESULTS

Initial observations on May 15 showed beetle cone losses to be heaviest in the untreated trees, 81.7 percent, and lowest in the early December 8 ounce treatment, 24.1 percent (table 1). The losses in the 6 and 4 ounce rates applied in late February were 62.1 and 65.7 percent respectively.

Two weeks later, another observation was made of each tree. On untreated trees, 82.4 percent of the cones present at the initial tally had been killed by the cone beetle. Nearly all of the cones recorded as being attacked by the cone beetle 2 weeks previous, had fallen from the tree. On one branch, of 57 cones tagged, only three healthy cones remained on the tree. The others were killed by the beetle.

On trees treated with the early December 8 ounce rate, 1.3 percent of the cones having attacks 2 weeks earlier survived and were healthy at the second observation. In total, only 22.8 percent of the cones were killed when the 8 ounce rate was applied the first week of December.

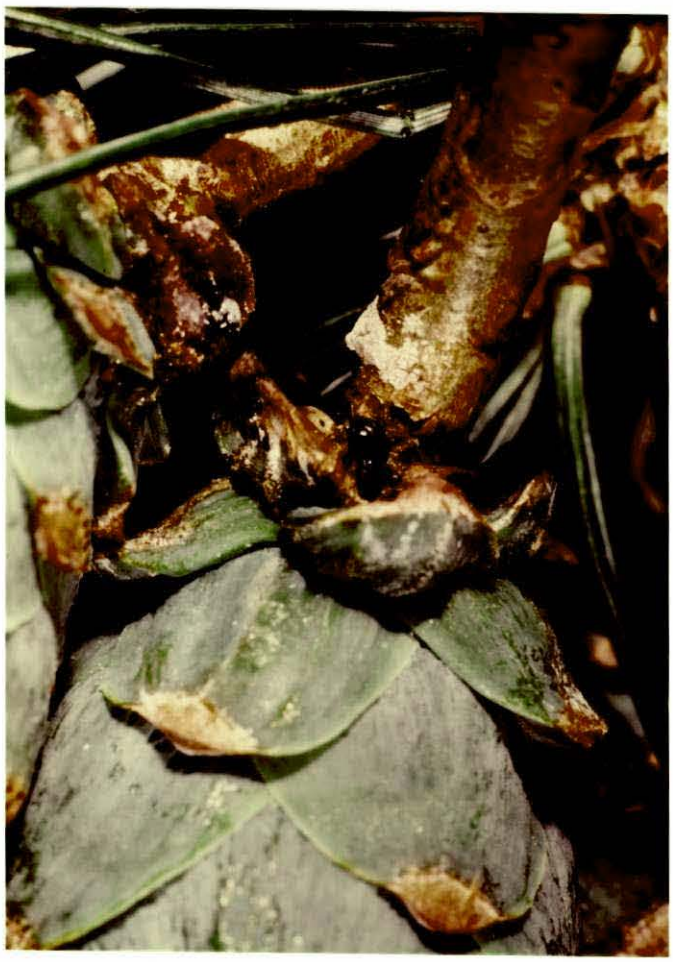
Nearly 16.4 percent of the cones treated with the late February 4 ounce rate, were able to overcome cone beetle attacks. They were apparently healthy and growing 2 weeks following the first observation.

After adjustments for attack recoveries, the resultant cone mortality from the cone beetle attacks, as of May 29, were 82.4, 22.8, 63.1 and 49.3 in the untreated, 8, 6, and 4 ounce/inch d.b.h. rates, respectively (table 1). The 4 ounce rate had attack recoveries higher (16.4 percent) than any of the other treatments. None of the cones in the untreated area survived a beetle attack.

The results of a multiple range test show the following significant differences among treatment means: untreated vs. 4 oz., untreated vs. 8 oz., and 6 oz. vs. 8 oz. at the 5 percent level (table 2).

In many cases, dead cone beetle adults were observed in an inactive pitch tube at the base of the petiole (figure 2). As many as three dead beetles

Figure 2. Adult white pine cone beetles entombed in pitch tubes



were found encased in the pitch on a single cone. The beetles were presumably killed by toxic carbofuran metabolites, as this phenomenon was observed only on treated trees.

White pine coneborer, Eucosma tocullionana Heinrich, damage was observed on May 29 on untreated trees only. No Eucosma attacks were observed on treated trees.

DISCUSSION

There was a documented loss of 22.8 percent of the cone crop on trees treated with carbofuran in December at the 8 ounce/inch d.b.h. rate. This represents a 361 percent reduction over untreated trees where 82.4 percent of the cones were killed. In the 4 and 6 ounce rates applied in late February, cone losses to the beetle were 49.3 and 63.1 percent, respectively.

It is interesting to note that the lower rate, i.e. 4 ounce, gave apparently better control than the higher 6 ounce rate. Possible reasons for this may be (1) sampling error, (2) equipment calibration error, or (3) some other unidentified problem. Irregardless, cone losses of either 49 or 63 percent are unacceptable.

The 1979 white pine cone harvest on the Edwards orchard was 480 bushels. As an overall average, cone beetle cone losses were estimated at 51 percent of the total potential cone crop present in early 1979. This equates to 497 bushels. Coneborer losses were insignificant in comparison.

Sampling cones for beetle attack may be more complicated than selecting cones at random, as we did in this evaluation. Don Rogers, in 1978, in a preliminary unpublished evaluation, found evidence of a higher rate of beetle attack in the top of the tree versus midcrown area (table 3). He noted that the attack rate was 40 percent on the uppermost cones as compared to 26 percent on cones at midcrown, for trees treated 2 years at the 8 ounce rate. On untreated trees, the rate of attack on the upper cones was 100 percent versus 80 percent at midcrown.

If such a preference does exist for cones in the uppercrown, a sampling error could have been responsible for the unusual insect control response in the 4 and 6 ounce rates which was demonstrated by less cone mortality in the lower rate. Additional work on this potential sampling problem is warranted.

Rogers' data suggest improved beetle control when trees were treated 2 years in succession. Of the uppermost cones, an additional 22 percent cone mortality was recorded on trees having received carbofuran only 1 year as compared with trees treated in 1977 and 1978.

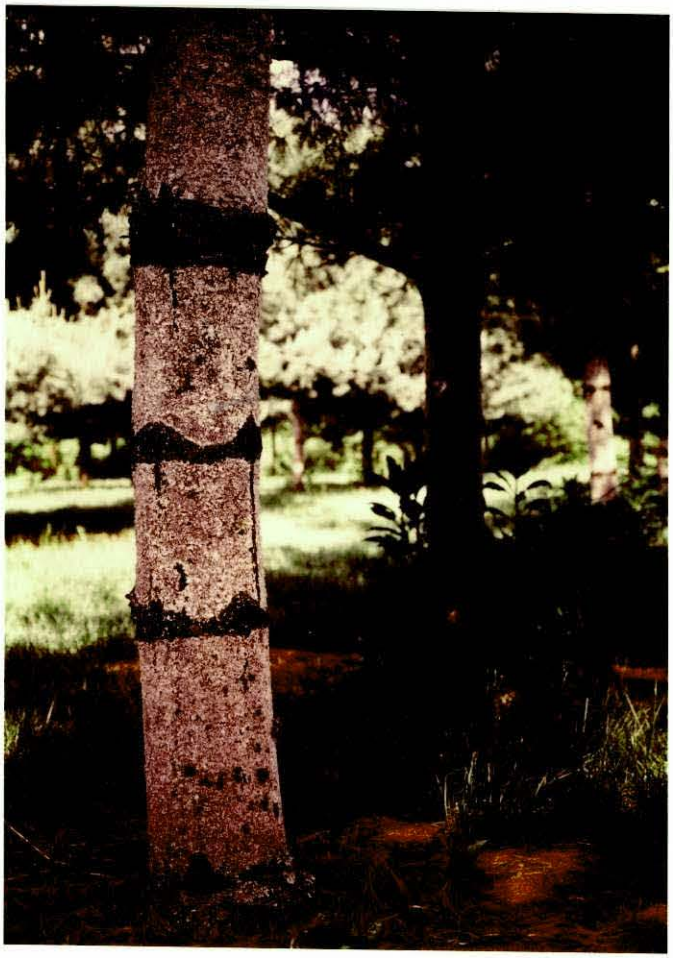
Calibration of the Turner applicator is described as inadequate. In this test the February 6 ounce rate was intended to be an 8 ounce rate. However, after measuring the amount of material applied, it was determined to be a 6 ounce rate.

In this evaluation the carbofuran was applied with the Turner applicator, however, the John Deere Powr-Till®Seeder is the industry standard for application of carbofuran. The primary difference between the two is that the John Deere Powr-Till®Seeder applies the insecticide in 12 trenches on each side of the trees, while the Turner applicator makes only two trenches. Logically, the most efficient system would be the one that made carbofuran most available to feeder roots. It would seem appropriate to test both of these machines next year on the Morganton orchard.

The pine bark aphid, Pineus strobi (Hartig) (D. E.), an insect introduced from Europe, attacks white, Scots, and Austrian pines. The insect is actually not a true aphid but belongs to the family Phylloxeridae (=Cherimidae = Adelgidae). Light infestations cause little damage, but persistent heavy attacks will cause reduced tree growth and may eventually lead to mortality (Johnson 1976).

Many orchard trees were heavily infested with the pine bark aphid (figure 3). This heavy infestation was surprising, considering the infested trees had

Figure 3. Pine bark aphids infesting eastern white pine tree trunks.



been treated the past 2 years with carbofuran at the 8 ounce rate. This observation further documents the ineffectiveness of carbofuran in controlling trunk and stem attacking insects. For example, in 1978, orchard managers across the South reported numerous cases of stem attacking Dioryctria spp. moths and isolated cases of bark beetle attacks on trees treated with carbofuran.

A possible explanation for this is (Dr. Gary DeBarr[6/] personal communication) that carbofuran metabolites are translocated up the xylem in sublethal concentrations. The transpiration of water from the needles, conelets, and cones concentrates the toxic metabolites in these structures at levels that are toxic to seed and cone insects. This hypothesis is however, unproven.

RECOMMENDATIONS

1. Apply carbofuran 10 percent granules at the 8 ounce rate/inch d.b.h. in early December to control white pine cone beetles.

2. Retest the 4 and 6 ounce rates in December.

3. If possible, compare these rates with the same rates when applied with the Powr-Till® Seeder.

4. Pine bark aphids should be sprayed with Malathion® according to label directions.

[6/] Research Entomologist, USDA-Forest Service, SE, Athens, Georgia.

LITERATURE

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DISCLAIMER

Mention of trade names is solely to identify materials used and does not constitute endorsements by the U. S. Department of Agriculture.

Table 1. Carbofuran rate and timing evaluation for white pine cone beetle control, Edwards Seed Orchard, Morganton, N.C. 1979

Rate	Time	5/15 % Cone Beetle Attack 1/	5/29 % Cone Beetle Mortality	% Unsuccessful attacks 2/
Untreated		81.7	82.4	0
8 oz. 3/	Early Dec.	24.1	22.8	1.3
6 oz. 4/	Late Feb.	62.1	63.1	0
4 oz. 5/	Late Feb.	65.7	49.3	16.4

1/ Includes all attacks
2/ Attacks by beetles on some cones were apparently pitched out or the beetles were killed.
3/ 8 oz. = 8 oz./inch d.b.h.
4/ 6 oz. = 6 oz./inch d.b.h.
5/ 4 oz. = 4 oz./inch d.b.h.

Table 2. Significance between untreated 4 oz., 6 oz., and 8 oz. carbofuran treated trees with respect to cone mortality. Were treatments significantly different from one another at the 5 percent level?

	Untreated	4 oz.	6 oz.	8 oz.
Untreated	Invalid	yes	no	yes
4 oz.	yes	Invalid	no	no
6 oz.	no	no	Invalid	yes
8 oz.	yes	no	yes	Invalid

Table 3. Percent white pine cone beetle attack rates at two crown levels, Edwards Seed Orchard, Morganton, N.C. 1978

	Treated w/carbofuran @ 8 oz. rate 1977 & 1978	Treated w/carbofuran @ 8 oz. rate 1978	Check
Uppermost cones	40	62	100
Midcrown cones	26	40	80